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Effect of Different Weaning Strategies on Survival and Growth of Endangered Fish Pengba, *Osteobrama belangeri* (Valenciennes, 1844) Larvae

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ABSTRACT

The effects of different feeding regimes on larval growth and survival of pengba, Osteobrama belangeri were investigated. Experiment was conducted for 25 days in fifteen FRP tanks filled with 50 L of water and larvae were stocked @ 2/litre. Larvae were fed with five different experimental diets varying on the type of food (Zooplankton, Groundnut oil cake, Rice bran, Soya milk and egg custard) and the time after hatching at which those different food items were offered to larvae were evaluated to find out most weaning strategies for pengba larvae. The result indicates that larvae at early weaning 7 days post hatch (dhp) show higher survival whereas late weaning 12 dhp showed higher growth rate. Considering the larval survival is key to larval rearing, early weaning is recommended for pengba larvae. This finding will help in improving the actual larval rearing techniques for this emerging pengba species.

Key words: *Osteobrama belangeri, Growth, Survival, Weaning, Zooplankton, Dry meal*

INTRODUCTION

Osteobrama belangeri (Pengba) is one of the most important carp fish emerging as potential candidate species for diversification of freshwater aquaculture in India, and have high market demand in Manipur and other North-East states. It has slow growth, but due to delicious flavor it fetches very good market price in North-East India. Moreover, the fish has almost vanished from the Loktak lake[16] and other water bodies of the Manipur. Furthermore, this fish species is categorized as threatened by the IUCN and it faces a high risk of extinction[4] (CAMP, 1997), which raises the issue of sustainable exploitation of this biological resource. Therefore, induced breeding and larval rearing should be considered as a high priority for culture intensification, diversification, conservation and restocking aspect [3,18].

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However, there is an urgent need for reliable, effective and efficient larval rearing techniques to ensure consistent production of good quality fry. Apparently, larval rearing is one of the important components for any successful aquaculture. It requires feed with high protein, a main source of energy which plays an important role in determining the growth rate in different life stages[11]. Several studies have been performed on the nutrition profiling of larvae and adults. It has been reported that the requirements for protein and essential fatty acids in larval fish are greater than in adult fish. These variations occur due to the morphology of the digestive organs, the digestive process and the feeding behaviour[6]. Special attention should be given for larval rearing, as this stage is more crucial than those of any stages of life cycle. The present study is carried out to determine the appropriate feed for larval survival and growth of pengba.

MATERIALS AND METHODS

The experiment was conducted at Carp section, Central Institute of Freshwater Aquaculture, Bhubaneswar, India. About 1500 hatchery-produced spawn (2dph) of Pengba (*Osteobrama belangiri*) were randomly selected for the trial. Prior to stocking, tanks were filled with plankton filtered pond water and provided outdoor condition with proper aeration. Five different dietary treatments varying in food type such as Zooplankton, dry feed or soya milk, egg custard and their combinations were given. All treatments were performed in triplicate. The different feed offered to pengba larvae were designed to find out the most convenient feeding regime and weaning strategy. Exogenous feeding larvae (3dph) were reared until 25 days (28 dph).

Before the start of experiment, one hundred larvae (2dph; average wet weight 1.31 mg) were stocked (2 larva l^{-1}) in fifteen circular FRP tank containing 50 litres of water. The larvae were fed two times a day (8:00 and 17:00 h) with different designed diets (Figure 1). Aeration in each tank was provided with air stone to promote a homogeneous distribution of feed in the water column. Through-out the rearing period dissolved oxygen, pH and water temperature were recorded *in situ*, whereas total alkalinity, total hardness and dissolved inorganic nutrients (total ammonia nitrogen, nitrite-nitrogen, nitrate-nitrogen) were analysed in laboratory, following standard protocols[2]. The tanks were siphoned daily during morning hours before feeding to remove uneaten feed and faecal residues.

Growth parameters

Fish larvae were sampled on 5^{th}, 10^{th}, 15^{th}, 20^{th} and 25^{th} day of culture to assess their growth performance (length, weight and specific growth rate). Ten larvae from each experimental tank were randomly sampled. Larvae were starved overnight before taking their weight. Three different parameters were considered for growth measurements i.e. percentage weight gain, specific growth rate (SGR) and survival rate. At the end of the experiment, all the tanks were dewatered and the number of animal in each experimental tank was counted. The following formulas were used to calculate different growth parameters:

$$\text{Percentage weight gain} = \frac{\text{Average final weight} - \text{Average initial weight}}{\text{Average initial weight}} \times 100$$

$$\text{SGR (\%)} = \frac{\ln \text{final weight} - \ln \text{Initial weight}}{\text{Number of days}} \times 100$$

$$\text{Survival (\%)} = \frac{\text{Total number of animal harvested}}{\text{Total number of animal stocked}} \times 100$$

Statistical analyses

To determine the significance differences between the mean of different growth parameter, survival were statistically analysed using statistical package SAS by one-way ANOVA and Duncan multiple range tests. Significant differences among treatments were tested at the 0.05 significant levels.

RESULTS AND DISCUSSIONS

In aquaculture industry, the production relies on larval survival and their rearing practices. Larval rearing depends mainly on the availability of suitable diets that are readily consumed and efficiently digested, this provides the required nutrients to support high growth and maintain good health. In general, adaptation of fish larvae to micro diets requires protocols to adapt them through a period of drastic morphological, physiological and behavioural changes according to nutritional and environmental requirements[21]. Moreover, developmental stages are the most important independent variable affecting growth performance and nutritional condition of the larvae[1]. Many authors have studied the effects of different nutritional diet on the growth performance of larval of different species[15,7,22,13,14]. However, information was lacking on the rearing of *O. belangeri*. Thus, we studied the effect of different feed combinations on their body growth (in terms of average weight and average length), SGR and survival rate. A significant difference in their body growth, SGR and survival rate was noticed when provided same environmental condition.

The larval growth in length and weight was recorded at 5-days interval throughout the culture period. Meanwhile, specific growth rate and percentage body weight gain were calculated. At the end of the experiment the total larvae were counted to calculate the survival percentage. The timeline data showed a gradual increase in average body weight and length of pengba larvae (Figure 2 & 3). Initially, average body weight and length were noticed to be about 1.31±0.072 mg and 7.00±0.27 mm. At the end of the experiment, an average body weight and length varied between 137.80±9.18 to 299.93±3.23 mg and 21.47±0.44 to 28.40±0.42 mm respectively. The data of different treatment groups were compared statistically and a significance difference ($P<0.05$) in average gain in body weight and length was reported. An average body weight and length were highest in "T-5" group (larva fed with zooplankton first 10 days, 11 to 20 days with zooplankton and dry feed and finally dry feed till 25 days of culture), whereas lowest gain in average body weight and length was reported in "T-3" group (larvae fed with Soya milk and Egg custard 1:1 v/w till 25 days). Moreover, an increased specific growth of larvae till 10th day of the culture and later gradually decreased (Figure 4). The highest specific growth rate was found in "T-5" treatment group, whereas the lowest in the "T-4" treatment group at the end of the culture period. The data were statistically compared and noticed that treatment group "T-3" and "T-5" were significant, the rest was found insignificant.

The significant changes in overall growth performance of the larvae may be due to some other factors that influence feeding such as type and size of the rearing tanks, size of the larvae, stocking density, quality and quantity of feed, production system etc[17]. During feeding practices, it was noticed that the growth (in terms of body weight) was initially higher when the larvae were fed with zooplankton, especially T-1 and T-5 treatment groups. Later, larvae showed good response toward GNOC and rice bran mixture (T-5 treatment group). These indicate that the hatchling of *O. belangeri* can be successfully weaned from live to artificial diet as compared to other treatment groups. However, Feed intake of fish depends on size of the prey and predator, quality, density, physical attractiveness and mode of presentation of food[12]. A study was performed by Harpaz *et al.*[10] and showed higher growth rate fry of *Poecilia reticulata* when they were fed with finely ground powder as compared to a flake form.

Furthermore, the survival rate of larvae was calculated at the end of the experiment and statistical analysis result showed significant difference among different treatment groups. The average percentage lies in between 53.64±1.57 and 94.55±0.91 (Table 1). Highest survival (94.55±0.91%) was found in T-4 treatment group, whereas other treatment groups have comparatively lower survival. This could be due to the improved

feed intake by the post-hatchling from live and artificial diets. Lowest survival (53.64%) was found in T-3 treatment group, where larvae fed with soya milk and boiled egg yolk. This may be because of soya milk and boiled egg yolk having very small particle size, that is mixed with water and making the culture water turbid. Moreover, egg yolk and soya milk get rotten readily in rearing system which impart in consequent deterioration of water quality, thus probably resulted in bacterial growth that enhance mortality in larvae. Many evidences showed poor growth and survival when larvae fed with egg yolk. Study on effect of six feeds (wheat flour, rice bran, soybean powder, prawn meal, zooplankton and cooked egg) on growth and survival of 2-day climbing perch larvae and reported that feeding eggs yolk to the larvae gives poor growth than live feed[19]. Poor growth and survival observed in climbing perch larvae when fed with egg yolk[8]. Another study by Rahman *et al.*[20] proved that the growth and survival of the *Clarius batrachus* larvae was poor when they were fed especially with egg yolk. Additionally, it was also observed that the cleaning process of the tanks fed with soya milk and egg yolk also contributed to death of few larvae.

At the end of culture period, percentage gain in body weight was calculated from the data obtained for average body weight (ABW). The percentage body weight gain was highest in "T-5" group (0.1308±0.005), whereas lowest in "T-3" group (Figure 5). There was no significant difference ($P<0.05$) in the percentage body weight gain. A preliminary study on feeding strategies of *Clarias macrocephalus* showed that the specific growth rate was higher when larvae fed with live feed than the artificial feed[9]. Thus, the performance might be higher in "T-5" treatment group because of long exposure to life feed and proper weaning of larvae to artificial feed with efficient feed intake[5]. The physical and chemical qualities of water in different treatment tanks were measured and found that the water quality lies in optimum range (Table 2) except larval tanks fed with soya milk and egg yolk. This might be due to more unused feed left in the rearing system.

Table1 : Survival percentage of pengba larvae in different feeding regime at 25 DOC

Treatments	Survival (%) (Mean + SE)
T1	87.58 ± 1.52^{c}
T2	81.82 ± 1.82^{b}
T3	53.64 ± 1.57^{a}
T4	94.55 ± 0.91^{d}
T5	89.39 ± 1.32^{c}

Table 2: Water quality variation express in Ranges and Mean±SE throughout the experimental period 25 DOC

Parameters	T1	T2	T3	T4	T5
pH	7.1-7.7 (7.3±0.07)	7.2-7.4 (7.3±0.08)	7.0-7.2 (7.1±0.06)	7.0-7.5 (7.2± 0.08)	7.0-7.3 (7.1±0.09)
Dissolved Oxygen (mg/l)	6.9-8.5 (7.9 ± 0.44)	6.8-7.6 (7.1± 0.40)	4.5-6.4 (5.5± 0.39)	6.8-8.0 (7.5± 0.53)	6.4-7.7 (7.1± 0.37)
Total alkalinity (mg/l)	53.3-58.7 (56.4 ± 2.1)	54-62 (58.7± 4.0)	57.3-68 (62.2± 2.8)	54-60 (56.0±2.7)	54.7-56 (55.1±3.9)
Hardness (mg/l)	64-88 (73.3 ±6.9)	70-110 (86.0±7.6)	52-89 (68.4±4.2)	60-88 (73.3±4.0)	65-75 (69.3±3.1)
TAN (mg/l)	0.13-0.46 (0.31± 0.09)	0.37-0.65 (0.51±0.20)	0.78-0.98 (0.62±0.20)	0.49-0.76 (0.60±0.32)	0.22-0.65 (0.41±0.13)
Nitrate-N (mg/l)	0.006-0.014 (0.010±0.003)	0.016-0.032 (0.022±0.012)	0.014-0.052 (0.029±0.009)	0.015-0.042 (0.029±0.008)	0.003-0.054 (0.022±0.007)
Nitrite-N (mg/l)	0.008-0.029 (0.021±0.004)	0.043-0.081 (0.056±0.011)	0.021-0.069 (0.040±0.003)	0.025-0.058 (0.041±0.007)	0.029-0.048 (0.036±0.010)

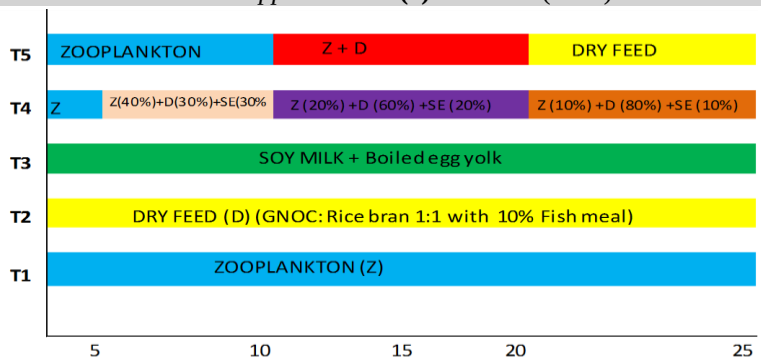

Fig. 1: Different feed weaning strategies for pengba larvae upto 25 days of culture (Z= zooplankton; D=Dry; GNOC-Groundnut oil cake; SE-Soya egg custard)

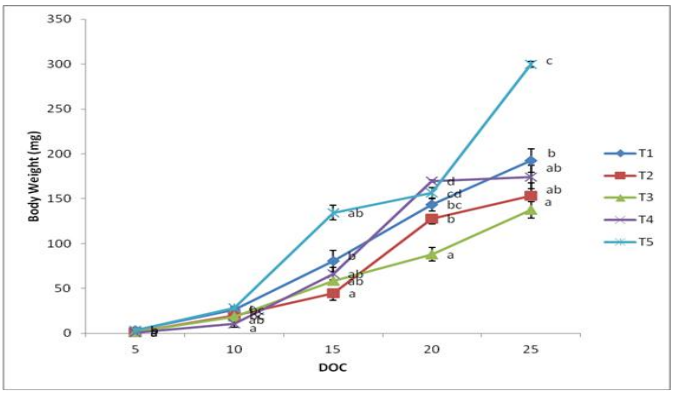

Fig. 2: Average body weight of larvae in different feeding regime at 5-days interval

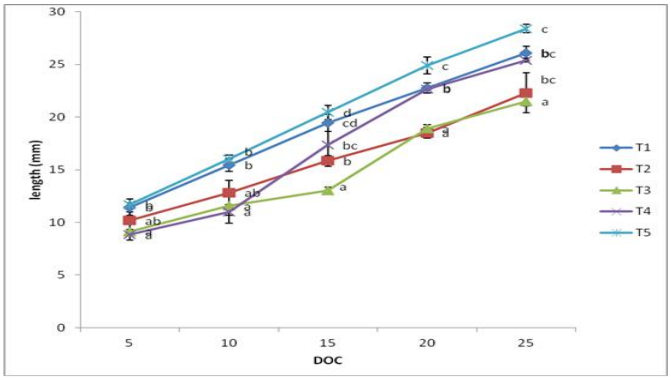

Fig. 3: Average body length of larvae in different feeding regime at 5-days interval

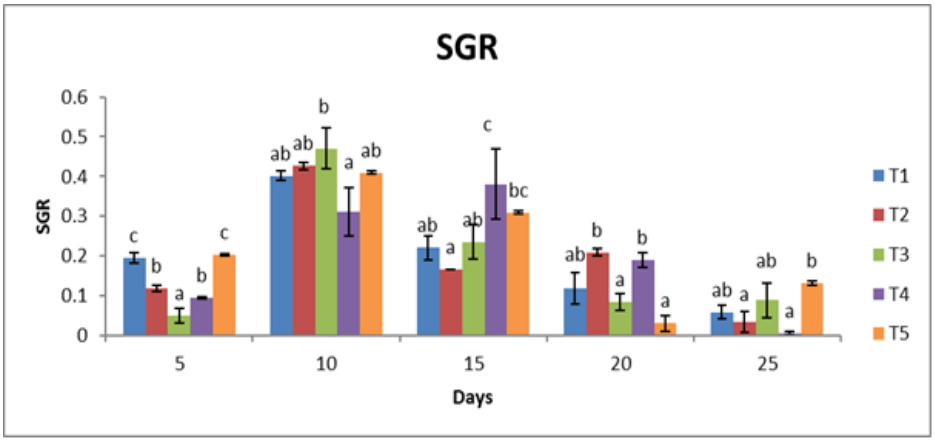

Fig. 4: Specific growth rate of larvae in different feeding regime at 5-days interval

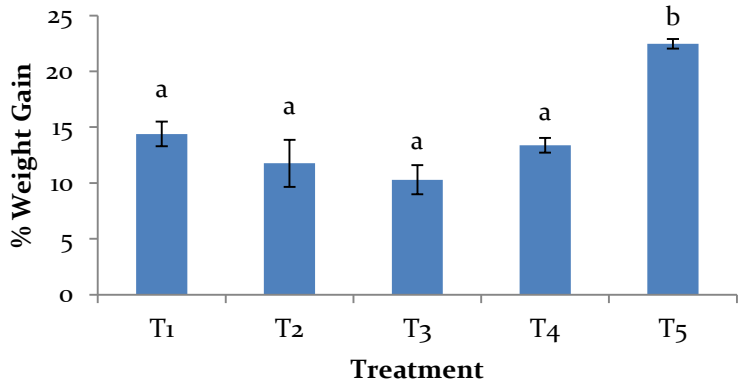

Fig. 5: Percentage body weight gain of larvae in different feeding regime groups at 25 DOC

Fig. 6(a-d): larval rearing trial in different feeding regime from starting to end of the trial a). 2dph larvae; b) experimental setup; c) Larvae at weaning period d) larvae at harvest

CONCLUSION

From this study, it may be concluded that the use of live feed (zooplankton) during initial stages and gradual weaning of larva with dry feed could be a potential diet for the early life stages of pengba.

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Conflict of interest: The authors declare that they have no conflict of interest.

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